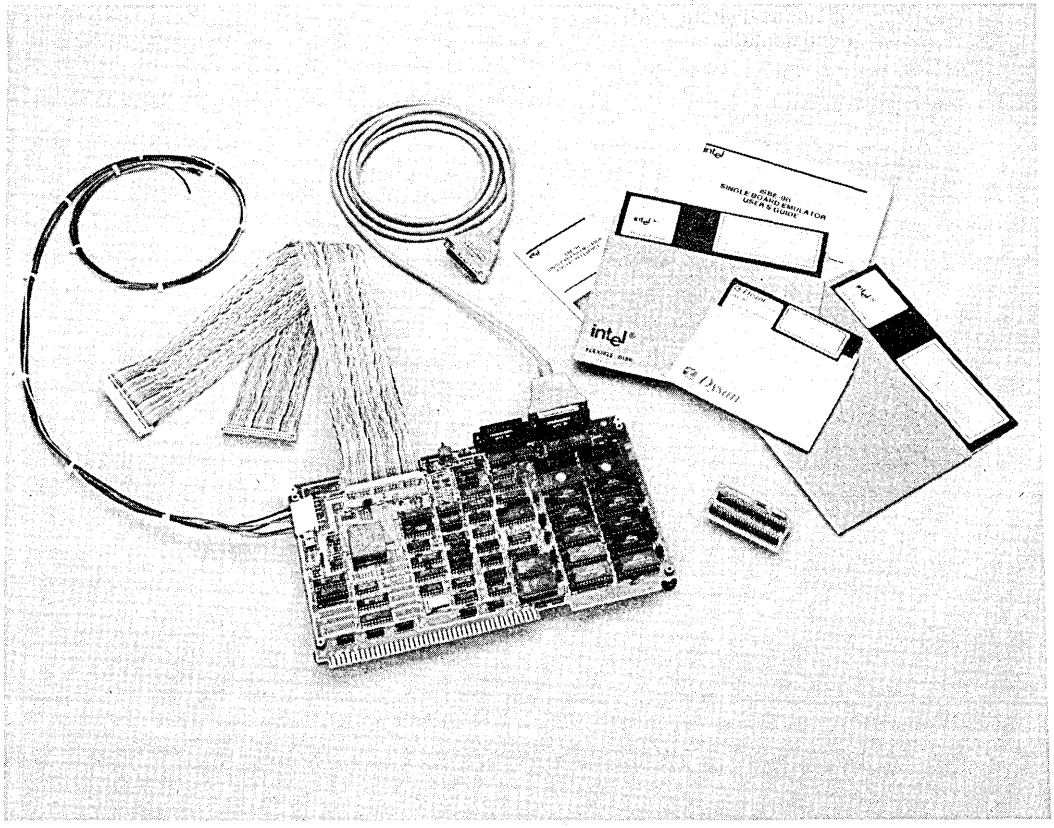
iSBE-96
SINGLE BOARD EMULATOR FOR THE MCS®-96 FAMILY OF MICROCONTROLLERS

- **Eight software execution breakpoints that can selectively be turned on and off**
- **12-MHz emulation speed**
- **Configurable serial I/O**
- **17.75K of on-board user memory**
- **Optionally expandable to 64K of on-board user memory**

The iSBE-96 emulator supports the execution and debugging of programs for the MCS®-96 family of microcontrollers at speeds up to 12 MHz. The MCS-96 family configurations are shown in Table 1. The iSBE-96 emulator consists of an 8097 microcontroller, a serial port and cable, and an EPROM-based monitor that controls emulator operation and the user interface.

The iSBE-96 emulator is a combination of hardware and software that permits programs written for the MCS-96 family of microcontrollers to be run and debugged in the emulator's artificial environment or in the user's prototype system. As a result, development time can be reduced by the early integration of hardware and software.



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FUNCTIONAL DESCRIPTION

Integrated Hardware and Software Development

The iSBE-96 emulator allows hardware and software development to proceed simultaneously. This approach is more time- and cost-effective than the alternate method: independent hardware and software development followed by system integration. With the iSBE-96 emulator, prototype hardware can be added to the system as it is designed; software and hardware integration occurs while the product is being developed. The emulator aids in the recognition of hardware and software problems.

Emulation is the controlled execution of the prototype software in the prototype hardware or in an artificial hardware environment that duplicates the microcontroller of the prototype system. The iSBE-96 emulator permits reading and writing of system memory, and control of program execution. The emulator also allows interactive debugging of the prototype software and can externally control program execution while operating in the prototype system. When the prototype system memory is not yet available, the iSBE-96 emulator's on-board memory permits software debugging.

Table 1. Configurations of the MCS®-96 Family of Microcontrollers

		68 Pin	48 Pin
Digital I/O	ROMLESS	8096	8094
	ROM	8396	8394
Analog and Digital I/O	ROMLESS	8097	8095
	ROM	8397	8395

iSBE-96 Software

The iSBE-96 emulator is shipped with three software disks: an 8 in. double-density and an 8 in. single-density disk for use with an Intellec® Series II/III, and a 5-1/4 in. disk for use with the Series IV development system.

The iSBE-96 emulator is supplied with an ISIS driver routine that communicates with the monitor software on the iSBE-96 emulator board. The driver interrupts the 8097 using the non-maskable interrupt (NMI) line for incoming keyboard input. The commands associated with the driver and the monitor are described in the following sections.

ISIS DRIVER

The iSBE-96 emulator is shipped with the ISIS driver software for use on the Series II, III, or IV development systems. The driver software provides a few easy-to-use commands. These commands are described in Table 2.

Table 2. ISIS Driver Commands

Driver Command	Function
EXIT	Exits the ISIS driver and returns to the ISIS operating system.
<CONTROL> C	Same as for the EXIT command.
HELP	Displays the syntax of all commands.
INCLUDE	Specifies a command file.
<CONTROL> I	Turns the command file on and off.
<TAB>	Same as <CONTROL> I (turns the command file on and off).
LIST	Specifies a list file.
<CONTROL> L	Turns list file on and off.
<CONTROL> S	Stops scrolling of the screen display.
<CONTROL> Q	Resumes scrolling of the screen display.
<CONTROL> X	eletes the line being entered.
<ESCAPE>	Aborts the command executing.

iSBE-96 MONITOR

The iSBE-96 monitor performs the following functions:

- Loads and saves user programs.
- Independently emulates user programs.
- Examines and changes memory contents.
- Examines registers.
- Maps the file capabilities of the serial ports (DS/DT).
- Maps different memory configurations.

The monitor commands are described in Table 3.

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Table 3. iSBE-96 Monitor Commands

Monitor Command	Function
BAUD	Sets up the baud rate.
BR	Permits display and setting of up to eight software breakpoints.
BYTE	Permits display and changing of a single byte or range of bytes of memory or a single byte of the 8097 internal registers.
CHANGE	Permits display and changing of a series of memory words or bytes.
<CONTROL> S	Stops scrolling of the screen display.
<CONTROL> Q	Resumes scrolling of the screen display.
<CONTROL> X	Deletes the line being entered.
<ESCAPE>	Aborts the command executing.
GO	Begins emulation and continues until an enabled breakpoint is reached or the escape key is pressed.
LOAD	Loads programs and data from disks.
MAP	Permits mapping of several prepro-grammed memory maps; also permits configurable serial I/O and selective servicing of the watchdog timer.
PC	Displays and changes the program counter.
PSW	Displays and changes the program status word.
RESET CHIP	Resets the 8096 to power-up conditions.
SAVE	Saves programs and data to disks.
SP	Displays and changes the stack pointer.
STEP	Provides single-step emulation with selective display formats.
VERSION	Displays the monitor version number.
WORD	Permits display and changing of a single word or range of words of memory or a single word of the 8097 internal registers.

Integrating Hardware and Software

When the prototype system hardware is developed, the iSBE-96 emulator interfaces to the prototype through two 50-pin ribbon cables. The emulator can then execute code from the iSBE-96 on-board RAM (or from user-provided memory) and exercise the prototype system hardware.

BLOCK DIAGRAM

Figure 1 is a block diagram showing the iSBE-96 emulator. The following sections describe each block.

The Processor

The 68-pin processor of the iSBE-96 emulator is used only in the 8097 external-access mode.

No adapter board is provided for the 68-pin versions of the 8096 and 8097 microcontrollers.

When debugging a 68-pin package, the two 50-pin ribbon cables are available to plug directly into 50-pin connectors on the user's prototype system.

When debugging a 48-pin package, the two 50-pin cables plug into the 48-pin adapter board, which is then plugged into a 48-pin socket in the prototype system.

iSBE-96 Emulator I/O

The iSBE-96 emulator's memory-mapped I/O devices are used to manage the system. These I/O devices are mapped into memory between locations 01F00H and 01FFFH.

Included as part of the I/O are two serial ports. One is configured as data set (DS) and the other as data terminal (DT). When operating with an Intellec development system, the data set port is used as the system console and the link for exchanging files.

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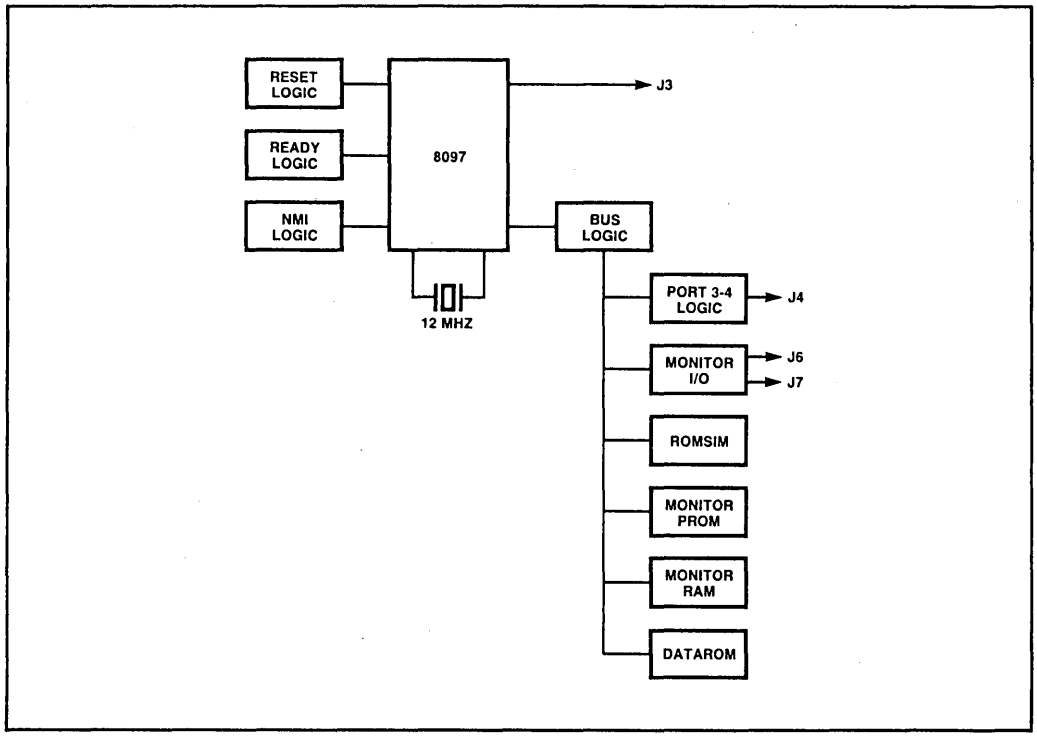

Figure 1. Block Diagram for the iSBE-96 Single Board Emulator

The serial ports are serviced under control of the NMI interrupt. The NMI interrupt has highest priority on the microcontroller and interrupts the user program when characters are entered from the keyboard. When in emulation, the monitor will still service inputs from the keyboard and execute certain monitor commands. Monitor activity is not totally transparent to the user.

Simulated ROM (ROMSIM)

There are eight 28-pin JEDEC byte-wide sockets with 2K-by-8 static RAMS present on the board. The partition on the user's prototype system that will be ROM is simulated by RAM on the iSBE-96 emulator board. This RAM facilitates easy program development, allowing users to correct and test problems in their programs.

ROMSIM can be expanded by replacing the iSBE-96 RAMs with 8K-by-8 static RAMs.

Port 3-4 Logic

The port 3-4 logic has two functions: to provide bus expansion and to provide I/O ports. The port 3-4 logic is controlled by a software switch available with the MAP command.

The iSBE-96 emulator reconstructs ports 3 and 4 of the 8394, 8395, 8396, and 8397 microcontrollers when the logic is defined by the MAP command as port 3-4. This port function should be selected when one of these four microcontrollers is intended as the target microcontroller.

When the BUS switch of the MAP command is specified, the iSBE-96 address/data expansion bus is available to the prototype system.

THE iSBE-96 EMULATOR MEMORY MAP

The target system should be designed with a memory map that is compatible with one of the iSBE-96 memory maps. Figure 2 shows the default address mapping. The following sections describe the areas of memory.

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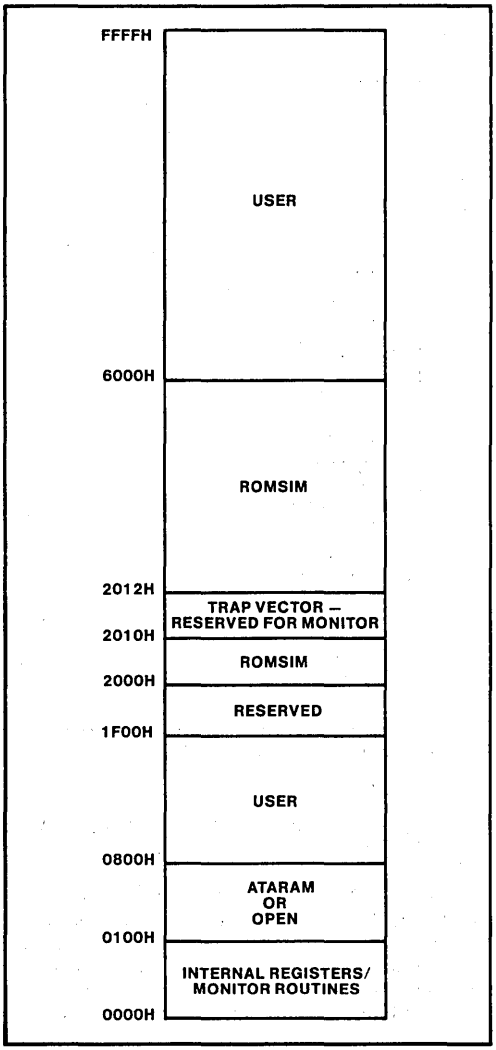

Figure 2. iSBE-96 Emulator Default Mapping

Internal Registers/Monitor Routines

Normally locations 000H through 0FFH contain the internal register space of the 8097. However, instruction fetches from these locations access external memory. This memory space contains the monitor's non-maskable interrupt service routine and utility routines.

For the monitor to access the user memory, the address and data is passed to the interrupt or utility routines. The routines then modify the mode register to enable user memory, disable all of the monitor's memory (except page zero), and perform the appropriate operation. After an operation is complete, the service and utility routines restore the mode register to its previous state and return to the main monitor code. The NMI service routine is used to handle the keyboard input on the serial port.

DATARAM

Locations 100H to 7FFH are mapped as the DATARAM space. This RAM is for general purpose use and is optionally enabled by using the MAP command. When the DATARAM buffer is not enabled, any access to this partition results in an access to user prototype system memory.

User Area

Locations 800H to 1EFFH are a user area. If an access is made to this partition, it is directed to the user's prototype system. Any memory mapped as I/O in the user system should be placed in this partition. With 8K-by-8 static RAMs, this area is located and available on the iSBE-96 board.

Reserved Area

Locations 1F00H to 1FFFH are reserved by the monitor for on-board I/O devices.

ROMSIM

Because some of the MCS-96 family of microcontrollers are ROMless parts, a user program can be loaded for execution into the on-board RAMs of the iSBE-96 emulator. Locations 2000H to 5FFFH are mapped to this RAM space; the space is called ROMSIM.

Trap Vector

Locations 2000H to 2010H are the interrupt vector locations. Vector address location 2010H is used by the iSBE-96 monitor for NMI.

User Area

The partition 6000H to 0FFFFH is mapped to the user proptotype area. During emulation any access to this partition is directed to the user's prototype system.

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EXPANDING ON-BOARD MEMORY

On-board memory can be expanded to a full 64K bytes by replacing the supplied 2K-by-8 static RAMs with 8K-by-8 static RAMs or PROMs. The user may also replace on-board ROMSIM memory with 2K-by-8 PROMs or even locate all 64K bytes of memory on the prototype system.

DESIGN CONSIDERATIONS

Designers should note the following considerations for designing with the iSBE-96 emulator:

- The iSBE-96 software uses 6 bytes of user stack space.
- Analog signal accuracy is impaired when driven over the emulator cable (up to ±50 mv loss of A/D conversion accuracy).
- The iSBE-96 emulator has some ac/dc parametric differences from the 8097 chip.
- The NMI vector is used for console service (Intel reserved interrupt).
- Keyboard activity during emulation affects real-time emulation because a 50 to 100 microsecond interrupt service routine is executed for every keystroke.
- The only hardware reset available for the iSBE-96 emulator is the system reset momentary switch (switch 1 on the emulator board).
- The prototype system interface cable is designed to support only the 48-pin package directly. Support for the 68-pin package is accomplished through the two 50-pin ribbon cables provided.
- User system memory should be configured to the iSBE-96 memory map (see Figure 2).
- The iSBE-96 emulator will not operate from a user system crystal.
- The iSBE-96 driver software is not compatible with the Intellec Model 800 development system.

SPECIFICATIONS

Equipment Supplied

Standard MULTIBUS®-size board assembly

EPROM-based monitor

Auxiliary power cable

RS-232 serial cable

Two standard, 18 in., 50-pin ribbon cables for connection to the user's prototype system

An adapter board for the 48-pin version of the MCS-96 microcontroller

One 8 in. single-density software disk for the Series II and III

One 8 in. double-density software disk for the Series II and III

One 5-1/4 in. software disk for the Series IV

Documentation

iSBE-96 User's Guide (Order number 164116)
iSBE-96 Pocket Reference (Order number 164157)

Emulation Clock

12 MHz supplied crystal

Physical Characteristics

Width: 6.75 in. (17.15 cm)
Length: 12 in. (30.48 cm)
Height: 0.75 in. (1.91 cm)

DC Electrical Requirements

Voltage	Current
+5v±5%	3.5a max
+12v±5%	0.06a max
−12v±5%	0.05a max

Environmental Characteristics

Operating Temperature: 10° to 40° C

Operating Humidity: 10% to 85% relative humidity, without condensation

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ORDERING INFORMATION

Part Number	Description
iSBE-96	Single board emulator for the MCS®-96 family of microcontrollers; with disks and documentation.